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Prof. C. V. Miles
With kind regards from the writer.

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USED FOR I. L.



PARIS-GREEN

(Or EMERALD-GREEN)

Its Uses, and Methods for its Application,

AS A MEANS OF DESTRUCTION OF

ORCHARD MOTH CATERPILLARS.

THE object in view in bringing forward the use of spraying with Paris-green is the pressing need which has long been felt of having some kind of application at hand which is cheap and sure in its action, and which can be brought to bear at once when required on any, or all sorts of, moth caterpillars together (whatever their various natures or previous histories may have been), and will kill the whole collection of ravaging hordes at once, without damaging the leafage.

For some years back trials have been made, in many isolated cases, of various kinds of treatment which it was hoped *might* be of use in lessening this yearly amount of loss; but as these experiments were seldom carefully recorded as to details or results, they have been of little public benefit.

Therefore, about the end of February in last year, 1890, at a conference of fruit growers held at Evesham, a Committee of Experiment was formed, of gentlemen personally interested in the subject (and also qualified practically, as well as scientifically, to superintend experiments in orchard treatment, and report results), in order to try the effect of any kind of sprays, washes, or other applications which they might judge likely to be effective in destroying the caterpillars on orchard trees without injuring the leafage; and to meet at various different centres from time to time, so that the whole Committee could judge of results of various treatments, and consultation and detailed reports of the method of treatment respectively take place, or be given by the members.

Paris-green was one of the applications especially selected for experiment, as having been known for many years to act trustworthily as an insecticide in the United States and Canada, and also because, from the Government reports of both

countries, we were able to learn all requisite details as to precise methods of application; and further, we were most kindly aided in our experiments by advice from Mr. J. Fletcher, the Dominion Entomologist of Canada.

At the meetings of the Committee the several experiences of the members were given, showing clearly that, even under careful experiment, just the same uncertainty occurred with regard to reliable effects of *almost* all the applications, as has appeared to be the case for years back. Alum, hellebore, ammoniacal liquor, and many other applications were tried, and sometimes found useful; sometimes, as in the case of alum, found occasionally useful, but also, and on very careful trial elsewhere, of not the slightest service; and later on, when the caterpillar was more advanced, the alum was found to be of no service at all.

Paris-green used as a liquid application—that is, mixed in an excessively small quantity with very much water, and sprayed as a mist on the trees—answered for the most part well; and I give the following directions for use, and also cautions required (the chemical being of a poisonous nature), from the Government publications of Canada and of the United States, together with our own experiences of last year.

For liquid application.—The amount recommended in Canada for spraying for Codlin Moth or young “looper” caterpillar is “not more than from 2 to 4 ozs. in 40 (forty) gallons of water, or $\frac{1}{8}$ to $\frac{1}{4}$ oz. in a pail of water (4 gallons, E. A. O.), to be applied as a fine spray by means of a force-pump. The foliage must not be drenched, but the spray should only be allowed to fall upon the trees until it begins to drop from the leaves.”

“*For general use on mature foliage.*— $\frac{1}{2}$ lb. of Paris-green, 50 gallons of water. First mix the Paris-green separately with a small quantity of water, then add to it the whole supply. All washes containing Paris-green must be constantly stirred to keep it in suspension, or it will sink to the bottom.”

The amount found serviceable by the Evesham Fruit Committee coincided almost exactly with the weaker mixture mentioned above. The Committee decided that they could recommend “Paris-green paste in the proportion of 1 oz. to 8 or 10 gallons of water for Plums; and 1 oz. to 20 gallons of water for Apples.” Apple leafage was found to be more tender than that of Plums. Pear leafage should be treated like that of Apple.

For Currants the strength found safe was the same as for Plums—1 oz. of “green” to 10 gallons of water; but as the foliage grew stronger, 1 oz. to 8 gallons of water was found

not too strong. Neither of these strengths of mixture damaged the leafage, but they killed the caterpillar.

These proportions should not be exceeded.—In some instances greater strength has been used without bad effects on the leafage; but this was certainly attributable, in one case, to heavy rain following the over-application, and probably, if details were procurable, non-injury from over-strength could be traced to casual coincidence in other cases also.

Capt. Corbett, the Superintendent of the Toddington Fruit Grounds, writing to me on the 3rd of July, and mentioning his satisfaction with the results of spraying, also noted, “The proportions I fixed upon after the first trials, *viz.*, 1 oz. to 10 gallons of water for Plums, and 1 oz. to 20 gallons of water for Apples, must not be exceeded.”

“*Paris-green*” is an aceto-arsenite of copper, and of a poisonous nature, and therefore should be used with care in mixing, and should never be applied to fruit or to vegetables that are used for food. But, as is shown above, the quantity to which, in order to be beneficial, it is *requisite to limit application* in spraying is excessively small, and our English experiences of the past season, as well as those on the Continent of America where Paris-green has been used regularly in farm and orchard prevention for many years, show that with proper care it may be used with perfect safety.

*The cautions to be observed in the use of Paris-green are:—*The bags should be labelled POISON and kept locked up, and especially kept safely out of the way of children, who might be attracted by the beautiful green colour of the powder.

Workers with the powder should not allow it to settle in any sore or crack in the skin of the hands, nor stir it about unnecessarily with the hands; and they should be *very careful not to breathe in the powder* through mouth or nose whilst measuring or mixing it.

For this reason it is most desirable that purchasers of Paris-green should have it sent *not* in bulk, to be divided for use on receipt, but wrapped in single pound (or small) packages by the senders, or, what is better still, have it in form mentioned opposite as “Paris-green paste,” that is, the powder just damped so that it cannot fly about. If swallowed in any quantity by being drawn in with the breath it would certainly be harmful. An instance is on record in which a man employed to weigh out and wrap 5 cwt. in 1 lb papers lost his life therefrom. But with the most ordinary care the application may be mixed and used, as well as hellebore and other poisons often applied in orchard and other farming work, with perfect safety.

In mixing and in the use of Paris-green as a fluid dressing, or spray, one of the first points to be borne in mind is that this chemical does not dissolve in water. It is simply held in suspension ; the following is a good recipe for mixing so as to ensure the powder and water being thoroughly mixed to start with:—“ Two bucketsful of water are first poured into the can, then three tablespoonsful of good green, well mixed with another half-bucketful of water and strained through a funnel-shaped strainer the use of which prevents the larger particles of the green from getting into the can and clogging up the sprinkler.”

The exact method of mixing, however, is quite immaterial—only remembering that the powder should be thoroughly diffused through the water, not allowed to be in lumps ; and also the methods are best which allow of the operator mixing without handling or inhaling the powder.

For the above reasons, and also for convenience in mixing, the “paste” form before-mentioned is preferable to the powder.

Mixture of flour with Paris-green.—The addition of flour to the mixture of Paris-green has been found to answer here, and has been strongly advised in the United States, because of the greater adhesiveness thus given, and also because the difference of colour helps to show the amount that has been distributed on the leaves. “Two or three pounds of flour” is an amount named as useful to add to a mixture of Paris-green in 40 gallons of water, but the precise quantity does not appear to be very important.

Where the plan is adopted of mixing flour with the Paris-green, the following method has been advised:—To take a large galvanised iron funnel of capacity suited to the work ; for filling a 40-gallon barrel a funnel of 13-quart capacity is noted. This funnel has inside it a kind of strainer (described as a “cross-septum”) formed of fine wire gauze, such as is used for sieves, and this also has vertical sides and a rim to keep it from rocking on the barrel. The quantity wished of cheap flour is placed in the funnel, and washed through the sieve-like wire gauze by water poured in ; thus the flour is finely divided and diffused in the water, and the Paris-green subsequently added and washed down in the same way by addition of the rest of the water until the barrel is full.

In application of Paris-green sprayings, it must always be borne in mind that, whatever kind of engine or spraying machine is used, the mixture must be kept an even strength throughout, and no sediment allowed to form at the bottom, or damage to leafage is sure to happen.

On these points Mr. Fletcher, the Dominion Entomologist of Canada, wrote to me as follows, and also enforcing care as to over-application:—

“*Paris-green*.—You are quite safe in recommending this; but insist upon these two things, *viz.*, 1st, to keep the mixture (which is a mixture, not a solution) well stirred all the time, and have the barrel well washed out after it has been filled ten or twelve times. The Paris-green is very heavy, and will keep sinking to the bottom unless constantly agitated; and as the barrel is frequently re-filled the residue will keep accumulating, until it will be too strong as the mixture reaches the bottom.

“2ndly. The other point is to insist upon the mixture not being made too strong; 1 lb. to 200 gallons I find very useful, and I never use stronger than 1 lb. to 120 gallons.”—(J. F.)

With regard to method of application of the spray.—This should be thrown so finely as to reach all parts of the tree and both sides of the leaves, and coat the leaves as with a fine dew, but it should *not* be allowed to run down and drip. As soon as dripping begins spraying should cease.

It should on no account whatever be thrown so as to “swill” or “souse” the trees, and run off the leaves in drops or streams; this is bad practice in every way. It uses a great deal more of the chemical than is needed; the leaves get little but pure water at their highest part, and much too strong application where the fluid has settled at the tips; and also a drip is caused on to the ground beneath, which may render the grass temporarily poisonous.

Also, spraying should not be done whilst the trees are in blossom, and warning is also given in the American works that sprayings should not be given in rapid succession. Several days, it is advised, should elapse between, unless of course, as may easily happen in difficulties of first experiments, the spray was manifestly so weak that the previous application counted for nothing. The effect of the Paris-green on the caterpillars does not always show directly, and it is undesirable to waste labour and material where the work is already done, and only requires a day or two to show it.

Non-feeding of animals under sprayed trees.—As it is totally impossible to guard against what may be done by careless workers, or those who will not take the trouble to understand what they are about, in all *we* (that is to say, the Experimental Committee as a body and myself personally) are desired to advise on, we most scrupulously direct that *cattle and stock and other animals should never be allowed to pasture or feed under trees that are being, or have recently been, sprayed*, for fear of injury from feeding on Grass on which there may

have been drip. We give no opening for possibility of mischief occurring from this cause where our advice is followed; but (having noted this duly) there is no harm in mentioning here that where the fine spraying is properly carried on, it is at least open to doubt whether any risk in the above way is incurred.

In the course of reporting it appeared that one observer fed his mares and foals beneath the Paris-greened trees with no ill effects. Mr. Lee Campbell, of Glewstone Court, Ross, also alluding to this point, wrote me:—"You will recollect that I sprayed the trees this year ten times with Paris-green, partly 2 oz. to the 20 gallons, and later with only one, and during the caterpillar season (in fact, all the year until the fruit was becoming ripe) fowls have had a free run all over the field."

With regard to Bees, as the trees should *not be sprayed when they are in blossom*, this gets over any fear of Bees being poisoned by sucking the honey.

Spraying machines.—One great point, in selection of spraying machines, is that either by mechanical contrivances (when on a large scale), or in the portable forms, by arrangements which will make the movement of the bearer serve the same purpose, the mixture should be so kept in movement that the powder should not settle down. It is necessary to keep the mixture in agitation during application, and also it is necessary to have the barrel "well washed out after it has been filled ten or twelve times." If this is not done the mixture will very soon be too weak at the top and too strong at the bottom, and the gradually increasing settlement will presently (in all probability) cause a seriously too strong overdose. The mixture should be kept at an even strength throughout, during the whole time of distribution, and also, as before mentioned, it should be so distributed that it will be thrown as a fine spray or mist, and will *rest and remain* on the sprayed leafage as a fine film or dew.

Various forms of apparatus would answer this purpose; but, to give mention of a few different kinds of spraying machines which have been found to answer here, there is, for use in fruit grounds where the trees are too closely packed with undergrowth for anything but a portable form to be admissible, the kind known as the knapsack sprayer. The knapsack pump, l'Eclair, No. 1, is a can or reservoir, which may be carried on a man's shoulders, and by means of a hose and nozzle throws a fine spray to the height of 14 or 15 feet. This spraying machine answers well so far as the spray reaches. It is procurable from the English agents of M. Vermorel, Messrs. Charles Clark & Co., Windsor Chambers,

Gt. St. Helen's, London, E.C. Price 35s., packed and delivered in London, at any railway station.

Another form of spraying machine is a barrel holding about 36 gallons of water, fitted with powerful pump and two jets and sprayers, and also automatic dashers for keeping the fluid properly mixed. The pumps will draw to a height of thirty to forty feet.

"The barrel is of course mounted on wheels, and has a pump fixed to the rear with two delivery pipes, to which are attached whatever length of tubing (india rubber) may be necessary. Three men go with the apparatus, two men to spray, and one to pump." Under ordinary circumstances of wind, this machine will spray 3000 trees in a day. The manufacturers are Messrs. Boulton & Paul, Rose Lane Works, Norwich. The price £8 15s.

The Strawsonizer is another form of sprayer that, where fitted for vertical delivery, may be expected to be exceedingly useful. Information as to different forms of this "air drill," for throwing fluid or dust dressings, would be procurable from the manufacturers, Messrs. R. Hornsby & Sons, Spittlegate Iron Works, Grantham.

In mentioning the above forms of sprayers, I in no way wish to infer that any kind is better than another, so long as it meets the essential requirements; but I am aware of the two first-named being successfully used. An ordinary garden engine *can be made* to serve the purpose, but this method involves great loss of material from quite unnecessary quantity of fluid spread abroad, and also great risk of over-application to the leafage.*

Paris-green, or Emerald-green as it is frequently called, is procurable at small cost. Probably retail traders would not furnish the pure article under 1s. 6d. to 1s. 3d. per lb. according to quantity; but Messrs. Blundell, Spence & Co. (Limited), of Hull, and 9 Upper Thames Street, London, Color Manufacturers and Exporters, with whom I have had much correspondence on the subject, inform me that they would deliver quantities of 14 lbs. and upwards carriage paid at 1s. per lb. packed in 1 lb. paper parcels, or in the paste state in large glass jars of 4 and 7 lbs. at the same price, jars free.

The Paris-green is also procurable from Messrs. Hemingway & Co., of 60, Mark Lane, London, E.C., and doubtless from many other good and reliable firms.

* Wherever any variation is made in form in which the Paris-green is procured, experiment as to strength of application safe to leafage should always be made before use on a large scale.

I understand that, in order to lessen difficulties arising from the "green" powder settling down in the water, it is the intention of Messrs. Blundell, Spence & Co., in the coming season, to grind the pulp or paste (that is, the Paris-green powder damped with water) to a much finer condition, so that the particles of powder being in this finer state will be much less liable to sink to the bottom of the fluid. This will be a great improvement, and the issue of this paste in glass jars will prevent difficulties regarding corrosion of metal caused by chemical action of the Paris-green.

This is a point that should be borne in mind in the use of iron or galvanised iron pumps or apparatus. These should be carefully washed out before being put away, or the bottoms may be corroded away by chemical action.

The above observations refer solely to the use of Paris- or Emerald-green as an application—*simply mixed with water for destruction of moth caterpillars* in the way in which we have found by many years' experience in America, and now by our own here, that with proper regard to directions and cautions, the work may be carried on with safety and great benefit.

ELEANOR A. ORMEROD.

TORRINGTON HOUSE, ST. ALBANS.

February, 1891.

P.S. It would give me pleasure to offer any information in my power regarding details of application of Paris-green, or to send a copy of this pamphlet to any applicants who may desire it for practical service.—E. A. O.